STATE & PRIVATE FORESTRY
FOREST HEALTH PROTECTION
SOUTH SIERRA SHARED SERVICE AREA

Report No. SS11-02 **File No. 3420**
January 11, 2011

To: Ramiro Villalvazo, Eldorado National Forest, Forest Supervisor
Tony Valdes, Eldorado National Forest, Forest Resource Officer
Duane Nelson, Placerville Ranger District, District Ranger

Re: Insect and Disease Risk Evaluation of the Raintree Forest Health Project.
Eldorado National Forest, Placerville Ranger District

Summary
Ever since its introduction in 2009, Forest Health professionals have been grappling with how to incorporate the ecological concepts outlined in General Technical Report 220 by North *et al* (2009) into an insect and pathogen focused Forest Health report. The Raintree Forest Health project provided FHP with an opportunity to produce a forest health assessment that combines the insect and pathogen biology with the resiliency ecology described GTR 220. Towards the end of this report (page 7), Figure 5 of North *et al* (2009) is reproduced and revised (with minimal changes) to show how the pest and pathogen biology of the Raintree project can produce the forest structure heterogeneity needed to produce the desired long term forest health and fire resiliency desired in Sierran Mixed-Conifer forests.

Introduction

This report by Forest Health South Sierra Shared Service Area relates to the Raintree forest Health Project. As the draft Environmental Assessment and all other documents related to the Raintree project are located within the Forest Service intranet: O:\NFS\Eldorado\Project\Placerville\Raintree2012 the reader is redirected to that location for the complete description of all facets of this project. Hence this report will focus on reflections made after site visits to the project area, a reading of the project draft EA, and a re-reading of GTR 220 (North *et al* 2009).

Healthy Forests Make A World Of Difference

South Sierra Shared Service Area
Stanislaus National Forest
19777 Greenley Road
Sonora, California 95370

*"**An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests**"* (North *et al* 2009), may well become one of the most influential documents, relating to management of Sierran mixed conifer forests. It is perhaps ironic that Forest health Specialists should turn to a document that so thoroughly discredits the concept of "forest health". In North *et al* (2009), Kolb *et al* (1994) is quoted as saying "***Various constituencies have different ideas of forest health (i.e., sustainable timber production, fire resilience, biodiversity etc) making forest health unclear as an objective."*** The authors were not belittling forest health professionals – they are stating a truth: Forest Health is a poorly defined and often misunderstood concept.

In the Raintree Forest Health Project there is a certain amount of vindication for North *et al* (2009). Placerville Ranger District proposes restorative and treatments to improve forest health; yet eight numbered action items, (in the opening of the Purpose-and-Need section) required to put the project area on a trajectory towards improved forest health, have more to do with fuels reduction, enhanced wildlife habitat, old growth characteristics, and recreational opportunity. There is a further irony that the project will be using the ubiquitous fungal disease *Heterobasidion occidentale* (aka *H. annosum* "S" type) to solve one of its problems.

Heterobasidion taxonomy.
Until very recently forest pathologists recognized two forms of the fungus *Heterobasidion annosum*, that causes Annosum root disease. The true fir form of Annosum root disease was caused by the "S" type of the fungus and the pine form of the disease was caused by the "P" type. However, in 2009 Otrosina and Garbelotto created 2 new species names; *H. occidentale* for the fir form and *H. irregulare* for the pine disease. The common name for the disease will become known as Heterobasidion root disease. We now have two fungi but still only one disease. While this is a mycological distinction it does not change the biology of the disease, it's just one more name to remember.

The problem that *Heterobasidion occidentale* (aka *H. annosum* "S" type) is being used to solve is that: there are too many white fir trees and not enough growing spaces for Sugar or Jeffrey pines. If *H. occidentale* is left unmanaged, white fir mortality will increase due to this root disease, and result in a biological thinning that promotes incense cedar dominated brush fields with occasional legacy pines and black oaks. If the root disease centers do not become filled with white thorn etc they will become filled with shade tolerant firs. These young firs will be healthy and remain healthy until their root systems expand and become root grafted. With the below ground landscape now dominated by a communal fir root system, any thinning that does not include a borate treatment will once more induce an outbreak of Heterobasidion root disease. The most important time to apply Sporax® is when the disease is at low levels.

Native diseases are neither totally bad nor totally good. Endemic levels of diseases play important roles as natural thinning or disturbances agents, keeping forests dynamic and sustainable. While *Heterobasidion* caused fir mortality may provide growing space to residual pines or provide planting sites for future pines, it will also increase downed woody material which may be benefit to small animals,or an increased risk of stand replacing wild fire.

In the short term, it could be argued that the project does little if anything to increase the health of white fir, providing most of the benefit to the pines and oak. The purpose-and-need section of

the Raintree EA outlines eight numbered actions required to meet improved forest health and ten other needs. It is because of these complex, often conflicting, objectives that forest health concepts become difficult to apply at the project level. However, it is possible to use the concepts of forest fire resiliency outlined in GTR 220 (North *et al*, 2009), and with minimal modification have them meet forest health goals of the Raintree project.

Thinning of pine plantations to minimize the risk of bark beetle outbreaks

In their GTR North *et al* (2009) make the point that when it comes to designing a thinning to increase resiliency to fires, in natural stands with a highly clumpy nature, reducing crown spacing might not be a high priority. These authors point out that many natural stands are composed of dispersed clumps of dense trees which have survived many natural fires. However, plantations within Raintree are not natural and have reached the point where they are susceptible to bark beetle attack. According to Oliver (1995), the minimum SDI threshold for bark beetle caused tree mortality in pine forests in California is 230, while stands above 365 are at imminent risk for bark beetle epidemics. This was evidenced by recent native Jeffrey Pine Beetle (*Dendroctonus jeffreyi,* JPB) activity detected in several scattered groups within plantations in the project area. When visiting one group that was estimated to have been attacked in 2008 and 2009, we observed adjacent, new 2010 attacks. Attacked trees were also found infested with pine engravers (*Ips* spp.) and red turpentine beetles (*Dendroctonus valens*). While basal areas in natural stands and plantations range widely, many of the plantations are overstocked and considered above the threshold for potential attack by bark beetles in pines (> 120 ft^2/acre). Evenly spaced treatments that meet bark beetle guidelines are not favored by North *et al* (2009), but are necessary to initially prevent large-scale loss. Heterogeneous characteristics favored by the ecologists can be implemented at future phases of stand development. By the next entry, plantations will have transitioned to mature stands and acquired some clumpy characteristics from insects and diseases plus understory regeneration. Perhaps the reason that natural stands appear clumpy is because they were subjected to periodic fires, root diseases and bark beetle attacks that broke up the uniformity.

Fir trees that share a root system share a disease

While visiting a cluster of fir trees that would make an ideal group for leave, we observed two things: first, we noticed a large amount of large diameter downed woody debris; secondly, we noticed that an old fir stump bore a callus ring indicating that the stump root system was alive and grafted to at least one adjacent large fir tree. There were no adjacent small fir trees. Examination of the grafted stump revealed that there was a large decay cavity in the top of the stump and within it were several actively sporulating *Heterobasidion* conks. Judging from the stump state of decay, we assumed the tree had been salvaged at least a decade earlier and the fungus had long ago decayed most of the above ground wood in the stump. Today the nutrients that were used to produce the current crop of spores may well have come from the now decayed part of one of the adjacent living trees. Thereby, part of this potential leave group is *Heterobasidion* infected.

Heterobasidion root disease

The most significant disease problem within the National Forests of the South Sierra Service area is Heterobasidion root disease and most of these problems arose from past foresters not understanding the long term implications of their actions. During the time of railroad logging

when the focus of forestry was simply timber production, little attention was given to what was then known as *Fomes annosus.* Because the disease was much less prevalent than presently (at least on Eldorado and Stanislaus National Forests), it was not thought necessary to take preventative actions. After fires or other salvaging operations, forest pathologists were not aware of the problem they were letting develop. As more and more pine was harvested, shade tolerant true firs became more common along with their disease. As the forests became less heterogeneous, and below-ground landscape became dominated by root grafted firs, the fungus grew to be a larger problem. One of the greatest advantage of North *et al*'s heterogeneity (2009) lies in the fact that it will break up the below ground landscape and restrict the opportunity *Heterobasidion occidentale* has to infect new root systems. *H. occidentale* cannot infect living pine root systems or freshly cut pine stumps. Thus if an infected fir is surrounded by pines or cedars, the fungus cannot spread to adjacent root systems. Stand heterogeneity will break the fungus's vegetative spread below ground and timely applications of Sporax® will prevent stump infection by spores (above ground).

While the authors have not found the pine disease (*Heterobasidion irregulare*) in the stands of the Eldorado National Forest, it is presumably today slightly less common than *H. occidentale* (the fir fungus) was prior to steam logging. To prevent a repeat of **fir** Heterobasidion problem with the **pine** Heterobasidion, the next entry into pine plantations it will be essential to apply Sporax® or some other approved borate treatment to all pine stumps over 14 inches. First thinning of the pine plantations will not have stumps over 14 inches, thus there should be no need to apply Sporax® to pine stumps at this time.

It has been argued by some foresters that Sporax® application in a fir dominated stand severely infested with Heterobasidion buys little, because the fungus is already established (below ground) within what is essentially a communal root system. However a sign in your pathologist dentist's office has given him pause to think again. The sign reads *"You don't need to floss all your teeth; you only need to floss the ones you want to keep!"* Following the same logic the pathologist would now claim ***"You do not need to Sporax all your stumps just the fir stumps adjacent to the firs you want to keep!"*** We have already recorded living root grafted stumps associated with what would be ideal leave islands. While we expect the next 30 -50 years to lead to more fir deaths from Heterobasidion root disease we do not know which root systems are still disease free. Only one or two trees in each small cluster has to live for another 100 to 150 years to provide legacy firs that will become the decadent den / nest or rest / roost trees that GTR220 promotes. Sporaxing the margins of "leave islands" is a cheap insurance policy against the uncertainty of the next century.

At the turn of the century and the advent of steam logging, forestry was about producing timber. Today, forestry is about ecosystems management. Back then, we did not appreciate the impact Heterobasidion was to have, as stands were allowed to develop a high fir component. However, we now know what failure to apply an approved borate protectant can lead to, and for these reasons we strongly recommend its use.

The web sites listed below provide links to the most important literature on this disease and the optimal protective measures.

Heterobasidion Information http://www.fs.fed.us/r5/spf/fhp/heterobasidion.shtml

- R5 Insect & Disease Manual: *Heterobasidion* (pdf 1.9 MB)
- R5 *Heterobasidion* Handbook (pdf 98 KB)
- Cellu-Treat Information, Product Label, and Material Safety Data Sheets (pdf 356 KB)
- Otrosina Heterobasidion taxonomy paper (pdf 1.5 MB)
- CA Forest Pest Conditions 2009: *Heterobasidion* (pdf 2.4 MB)

There is a white paper that should be considered prior to beginning a project-NEPA document. This white paper can be found at :http://www.fs.fed.us/r5/spf/fhp/pesticide/index.shtml It is referred to as the pesticide use advisory memorandum 06-01 (two documents on the web page, the cover letter and the attachment (which is the white paper). The attachment responds to Issues Raised by CATs Concerning Borax (Sporax®) and was authored by David Bakke, Regional Pesticide-Use Specialist. There is also a national risk assessment for "Borax" fungicides that discusses human as well as ecological health risks, located on-line at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

While David Bakke (Regional Pesticide-use specialist), Phil Cannon (Regional pathologist) and others have been working on updating the Forest Service regional policy on Sporax®, some of the work is still ongoing and a draft can be provided if requested. As soon as the update comes back from review, it will be listed on the first web site.

Alternative Options for Treatments:

- *Leave Islands that are groups of large trees.* Having observed several small islands of large firs on the Sierra National Forest we were struck by two facts, first the islands frequently had a highly convoluted boundary and secondly the boundary-transition forest was frequently lightly stocked. While forester claim that the big trees in these small groups have root systems that tap into water supplies held in fissures in the underlying strata all of the windthrown big trees that we have examined have had a large circular root plate and little evidence of deep tap roots. Regardless of the presence of a deep root system for these islands of big trees, if there are a large number of small trees within or adjacent to the islands they will absorb the moisture before it can seep into the deep fissures the big trees could tap into. Thus we recommend thinning heavily beneath the drip lines of the big trees and a feathered thinning around the leave islands to, not only reduce ground and ladder fuels, but also to allow lateral root growth by the large trees. While these might be small islands of large trees we believe their continued existence depends upon them having long convoluted perimeters and a light stocking at their boundary.

- *Old landings from previous salvage operations.* We observed several old landings that were now well established in incense cedar and also contained a few pines. As this constitutes advanced regeneration we advocate not re-using old landings if they already have a conifer cover.

- *New landings in root disease centers.* Having seen several root disease pockets we suggest, where feasible, locating new landings in existing root disease pockets and endeavoring to have skid trails go through adjacent pockets. The scarification that this harvest activity will produce may a better seed bed for conifers. And as the conifers are immune to the fir Heterobasidion root disease, what better place to get pines established. It must be remembered that wounds on fir trees are easily infected by *Heterobasidion* spores. For this reason every effort must be made to avoid damaging residual trees and any turn or rub tree that is used in the skidding must be removed, and if appropriate, Sporax® treated.

- *Planting Gaps.* While the draft EA calls for planting gaps of ½ to 3 acres, we note that the SNFPA final supplemental EIS (R.O.D., 2004) calls for a desired future condition involving vegetation groups ranging from ½ to 5 acres. There is evidence from plantings on the Stanislaus National Forest that seedlings planted closest to the edge of the gap grow slower than the seedlings further away from the surrounding trees. Presumably this is due to the large edge trees taking moisture away from the seedlings. Additionally there is evidence from gap planting on the Sierra National Forest that the orientation of the gap with respect to the passage of the sun can impact the seedlings growth rate. Consequently we favor larger gaps and based upon our observations of root disease pockets we are sure they can be found. Larger gaps should reduce the cost of subsequent release of the planted pines.

An expression the Raintree Forest Health project following the GTR 220 model

Although, North *et al* (2009) point out that the ideas of Forest Health are so varied and open to interpretations so as to make limited value in managing the mixed conifer forest type. On the next page (page 7) we would like to take a page from North *et al* (2009) and express it as a Forest Health management strategy. In this case we have chosen figure 5 from page 16. The figure in question first appeared as Figure 1 in Johnston *et al* (1998). In that publication the authors make the point that the depicted landscape was managed by the use of prescribed fire. However, as Slaughter and Rizzo (1999) point out past forest management promoted root disease in Yosemite Valley. While *Armillaria* root rot is common in Yosemite Valley, the root disease picture (below ground landscape) is dominated by Heterobasidion root disease (Rizzo *et al* 2000).

While the above ground landscape in Figure 5 may have been maintained by prescribed fire (Johnson *et al* 1998) it may also have been initiated by below ground expansion of Heterobasidion root disease centers (Rizzo *et al* 2000). If these conclusions are reasonable, there is a high probability that Raintree project will result in desired future conditions it proposes to produce. By thinning the plantations, a future supply of Jeffrey pine seed is ensured. Planting blister rust resistant sugar pines will establish means to eventually reproduce and sustain this species. The application of Sporax® to the cut stumps surrounding "leave islands" of large trees will slow down the rate at which the fungus infects fir trees. If root disease created clusters of large trees in Yosemite Valley, there is reason to believe it will do the same in Raintree project area.

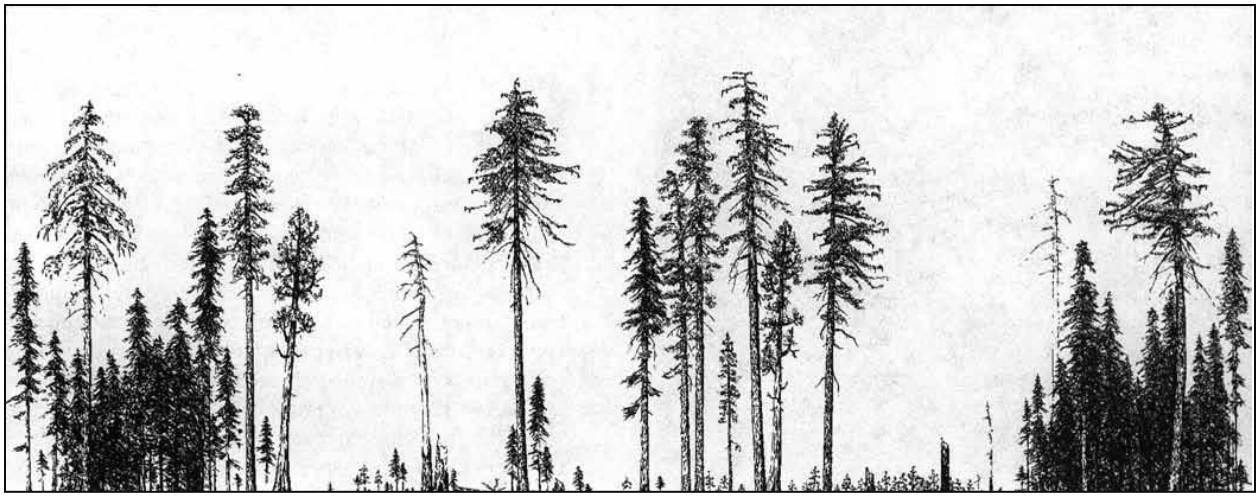
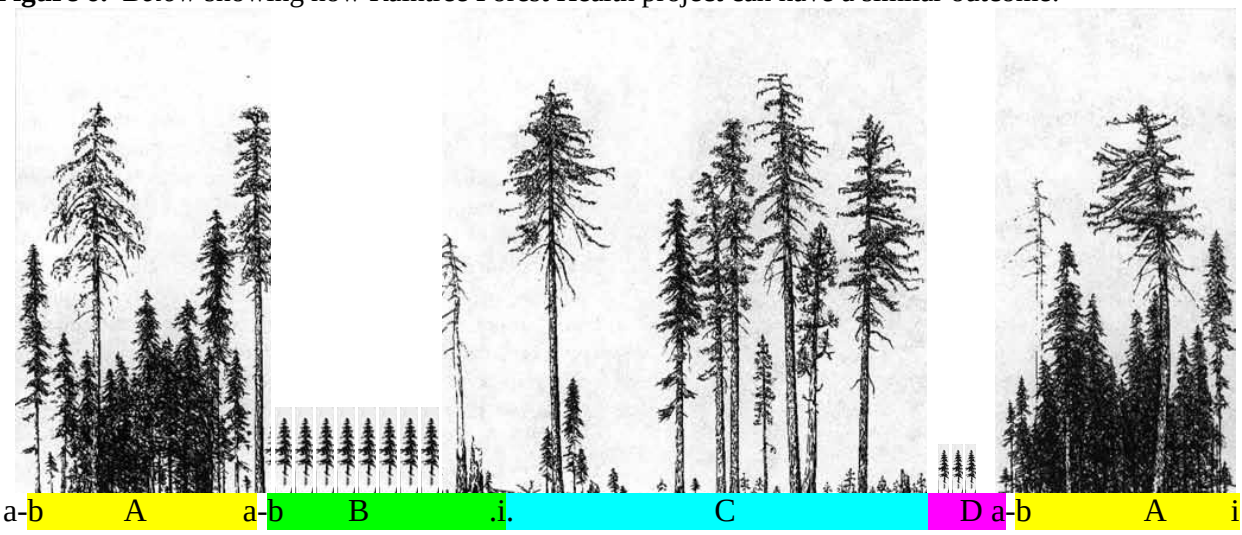


Figure 5. A*bove* From North *et al* (2009) showing their view of a resilient heterogeneous forest.

Figure 6. B*elow* showing how Raintree Forest Health project can have a similar outcome.



A Leave islands of healthy dense forest. These are the islands that will produce the legacy roost/ nest trees or den/ rest trees

B Thinned plantation of tall spindly trees not yet clumpy. These plantations will be thinned to bark beetle proof them. We expect some snow breakage, and some *Ips* activity. Once the stands have stabilized they will need another thinning in 20 years before becoming the founder seed source for Jeffery pine of the next century.

C. The bulk of the project area that will provide the bulk of the fuels reduction, product production and recreational improvements etc. Within this zone we expect Heterobasidion root disease to continue to drive a conversion from fir to incenses cedar and pine survivors with shade tolerant fir regeneration (depending upon the return of fire and seed sources).

D. The gap plantations of blister rust resistant sugar pine that will be the "Founder effect" seed source for the next century.

a-b or a-b buffer zones where Sporax® must be used to prevent the intensification of Heterobasidion root disease, while we can live with the disease in the general area C, we must suppress it in these leave islands.

Forest Health Protection supports proactive management that seek to retain stand integrity while improving overall stand resiliency and resistance against potential insect/disease infestation or other disturbance agents. Proposed management activities will also benefit other project objectives such as fuel reduction/wildfire prevention. The strategies outlined by the district for forest health improvement are concurrent with FHP prevention objectives and desired outcomes. If you have any concerns or require further information regarding this report, please do not hesitate to contact us.

Beverly Bulaon
Entomologist
Forest Health Protection
(209) 532-3671 x 323
bbulaon@fs.fed.us

Martin MacKenzie
Plant Pathologist
Forest Health Protection
(209) 532-3671 x 242
mmackenzie@fs.fed.us

cc: Julie Lydick
Sheri Smith
Phil Cannon
Dave Bakke
Tim Howard

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